Co-Voting Patterns in the Dutch Parliament: A Social Network Analysis Approach

Group 17

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Table of contents

1 Introduction

Over the past decades, the Dutch political landscape has become increasingly fragmented. Of the 54 registered parties, 15 currently hold seats in the House of Representatives, hindering formation of stable majority coalitions (Otjes & Louwerse, 2015a). The repeated government collapses since 2017 underline this structural tension: as the number of viable parties grows, ideological distances widen, further complicating coalition formation and stability (Schmitt, 2016). This study examines parties' voting agreement on motions in the 2023-2024 parliamentary cycle. Using social network analysis, it explores both structural voting patterns and the factors shaping them. To do so, the research consists of two complementary studies.

1.1 Study 1

This first study examines whether voting agreement between political parties changes between two periods: (a) the year before the 2023 elections and (b) the year after the new cabinet was formed. To explore this, the study answers the following research question:

> RQ1: Is the way Dutch political parties vote different in motions before elections compared to after cabinet formation?

Previous studies demonstrate that parliamentary voting behavior adapts to political and institutional contexts. (Lami, Cristoforetti, Jurman, Furlanello, & Furlanello, 2014) proved that party alignment of the Italian Parliament changed substantially after government transitions, observing differences in cohesion and community structure over time. Additionally, (Louwerse, Otjes, Willumsen, & Öhberg, 2017) showed that cooperative behavior of government and opposition differ. Cross-party support tends to decline during election campaigns but intensifies after the formation of a new cabinet. These findings present that shifts in political context can lead to different voting behavior. Therefore, the hypothesis for this research question is the following:

> H1.1: Dutch political parties show different levels of voting agreement before elections compared to after cabinet formation.

Two weighted voting agreement networks will be created, with nodes representing political parties and edge weights indicating the ratio of motions for which two parties voted the same. The first network is based on votes in the year preceding the 2023 elections, and the other based on votes in the year following cabinet formation. To test the first hypothesis, a Quadratic Assignment Procedure (QAP) correlation test will be employed.

1.2 Study 2

The second study focuses on the factors driving voting agreement between Dutch political parties for both networks from Study 1. The research question is:

RQ2: How do ideological similarity, shared coalition experience, and structural voting patterns influence inter-party agreement on parliamentary motions?

The ideology of a political party reflects its core beliefs and values about how society should function (Corcoran, O'Flaherty, Xie, & Cheung, 2020). It is typically measured on a left-right axis, though literature argues that this does not fully capture political orientation (Van Erkel & Turkenburg, 2022), leading to proposals for a bi-dimensional approach (Boräng, Naurin, & Polk, 2024). In the Dutch context, a second cultural progressive-conservative dimension is widely recognized. However, cultural issues also influence left-right positions (De Vries, Hakhverdian, & Lancee, 2013), suggesting that the two dimensions may be too closely intertwined (see Section 2 for empirical validation). Since ideology shapes positions on political issues, it plays a central role in voting behavior. Research repeatedly finds that ideological similarity between parties positively influences their voting similarity (Fowler, 2006; Shiraito, Lo, & Olivella, 2023). Therefore, the first hypothesis is:

H2.1: Parties with similar ideologies on the left-right spectrum are more likely to agree on motions.

Coalition formation is an essential component of government formation. Coalition parties often have to reach agreements to facilitate effective policy-making. Research shows that these agreements are effectively enforced in the Netherlands (Moury & Timmermans, 2013) and that they help parties agree on policy reforms (Bergman, Ilonszki, & Hellström, 2023). Furthermore, (Hahm, Hilpert, & König, 2024) show that coalition experience between parties reduces affective polarization in the public opinion. Building on these insights, coalition experience between parties may similarly strengthen party trust and coordination at the parliamentary level. Hence, the following hypothesis is proposed:

H2.2: Parties that have often been in a coalition together are more likely to agree on motions.

Relationships between parties can also be understood through broader structural patterns. One such pattern is group formation: parties that frequently vote together tend to do so within larger groups rather than isolated pairs. This can be explained by a familiarity mechanism. When two parties both agree with a third, this shared connection signals ideological compatibility and reduces uncertainty between them (Bäck, Hellström, Lindvall, & Teorell, 2024), increasing the likelihood that they will also agree with each other. As this process repeats across parties, cohesive groups of voting cooperation emerge. The following hypothesis is proposed:

H2.3: Parties are more likely to agree on motions if they share agreement on motions with a third party.

Structural difference also lies in parties' overall voting similarity with others. Some parties show high voting agreement with many parties across the political spectrum, while others maintain more exclusive voting patterns. Research indicates that certain parties function as important intermediaries in parliamentary voting, as they are able to cooperate with a wide range of political actors (Dal Maso, Pompa, Puliga, Riotta, & Chessa, 2014). In Dutch politics, centrist parties like CDA and D66 have historically functioned as such intermediaries. Conversely, populist parties tend to maintain isolated voting patterns, avoiding the compromises necessary for broad voting coalitions (Otjes & Louwerse, 2015b). Hence, the following hypothesis is proposed:

> H2.4: Some parties are more likely to agree with many other parties.

The creation of motions is frequently performed by several MP's working in conjunction together, an approach called co-sponsorship. MP's introduce resolutions and amendments across party boundaries with those MP's who specialize in similar topics (Otjes & Louwerse, 2015a). MP's frequently tend to co-sponsor bills to signal approval for a motion (Kessler & Krehbiel, 1996). This agreement can originate from coalition membership as well as ideological similarity (Otjes & Louwerse, 2015a). Since voting unity within parties is almost 100% in Dutch politics (Andeweg & Irwin, 2009) co-sponsorship behaviour at MP level can be abstracted to the party level and results in the following hypothesis:

> H2.5: Parties who frequently co-sponsor motions tend to agree more with each other.

RQ2 will be answered using a GERGM, using terms depicted in Table 1.

Table 1: Hypotheses and GERGM Terms for Study 2

Hypothesis	GERGM Term	Motivation
H2.1: Parties with similar ideologies on the left-right spectrum are more likely to agree on motions.	`absdiff(LeftVSRight)`	The term absdiff measures how differences between node (i.e. party) attributes impact tie formation, capturing how differences in ideology impact voting agreement.
H2.2: Parties that have often been in a coalition together are more likely to agree on motions.	`edgecov(coalitioncount)`	The edgecov term measures how ties in a different setting impact tie formation. In the context of this research, a count variable for how many times parties have been in a coalition together will be used to capture its effect on voting agreement.

Hypothesis	GERGM Term	Motivation
H2.3: Parties are more likely to agree on motions if they share agreement on motions with a third party.	`gwesp`	Gwesp captures the tendency for parties with shared agreement for a third party to vote the same.
H2.4: Some parties are more likely to agree with many other parties.	`kstar(3)`	The kstar(3) term captures the tendency for some parties to form broader patterns of cooperation by agreeing with many others. Specifically, 3-star specifically reflects parties that maintain multiple voting agreements at once, identifying those that function as broad intermediaries.
H2.5: Parties who frequently co-sponsor motions tend to agree more with each other.	`edgecov(cosponsor_count)`	The edgecov term adds a dyadic predictor to the model. Here, a matrix counting how often each pair of parties co-sponsored motions is used to test whether co-sponsorship frequency increases voting agreement.

This research contributes to the existing body of literature by integrating structural network analysis with traditional political measures of ideology and coalition experience. It advances understanding of Dutch parliamentary voting patterns by identifying parties that act as key intermediaries, and provides empirical evidence about heterogeneity in party agreement patterns. Furthermore, it provides insights about how voting agreement is impacted by elections and coalition formation.

Section 2 details the data used for this research and Section 3 presents the adopted research rationale. Results shows the results for the two studies. Lastly, Conclusion formulates the conclusions and answers the research questions, also suggesting directions for future research.

2 Dataset

2.1 Data Sources and Collection

We combine multiple datasets to examine Dutch parliamentary voting patterns.

2.1.1 Primary Data

Primary data are voting records scraped from the Open Data Portal of the Dutch House of Representatives (Tweede Kamer der Staten-Generaal, 2024) via automated Python API queries (October 2025). The portal integrates four sources from which we use one: Parlis (motions and voting results). We extracted votes from two periods: November 22, 2022 – November 21, 2023 (pre-election) and July 5, 2024 – July 4, 2025 (post-formation), filtering for Voor/Tegen (in Favour/Against) votes only.

We construct party co-voting networks where nodes are parties and edge weights w_{ij} represent voting agreement between parties i and j. Table 2 shows raw voting statistics.

Table 2: Raw Voting Data by Period

Metric	Pre_Election	Post_Formation
Duration (days)	364	365
Total Votes	81,223	78,745
Unique Motions	4,758	5,009
Active Parties	18	16
Votes per Motion	17.1	15.7

Both studies exclude parties that were structurally absent or non-functional during the analysis period. We remove four parties from all networks: Omtzigt (an individual independent member, not a party faction), BIJ1 (lost parliamentary representation after the 2023 election), BVNL (no voting activity in our data), and 50PLUS (dissolved with only 2 votes in the pre-election year).

For Study 1, both networks include the remaining 17 parties with identical node structure, as required by QAP. For Study 2, we apply additional period-specific filtering to account for party mergers and formations since running parallel ERGMs does not require the same node sets, resulting in 15 parties for each period.

Before determining the thresholds for binarizing the network to prepare for the ERGM analysis, we transform the raw weights into agreement rates by dividing the weights by the total number of motions in each period:

$$w_{ij}^{\text{normalized}} = \frac{\text{Agreement Count}_{ij}}{\text{Total Motions}}$$

This normalization produces agreement rates as fractions (0 to 1).

Based on the distribution of agreement rates in both networks (see Figure 1), two potential thresholds for binarizing the weighted network were evaluated: a threshold at the mean and a threshold at the third quartile (Q3). The theoretical rationale for this threshold selection is provided in the Appendix (Section 4). Figure 2 shows the resulting network structures and in Table 3 we see that the stricter Q3 threshold produces sparser networks compared to the mean threshold. The Q3 networks mainly differ in transitivity: the pre-election network shows highly clustered voting patterns (0.89) while the post-formation network shows more dispersed patterns (0.61).

Figure 1: Agreement Rate Distributions by Period. Rates are expressed as percentage of total motions in each period.

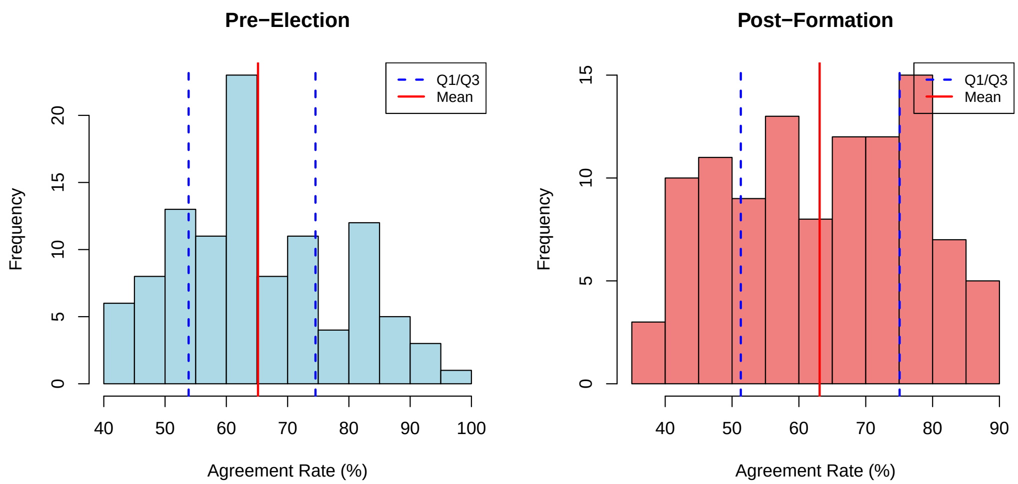
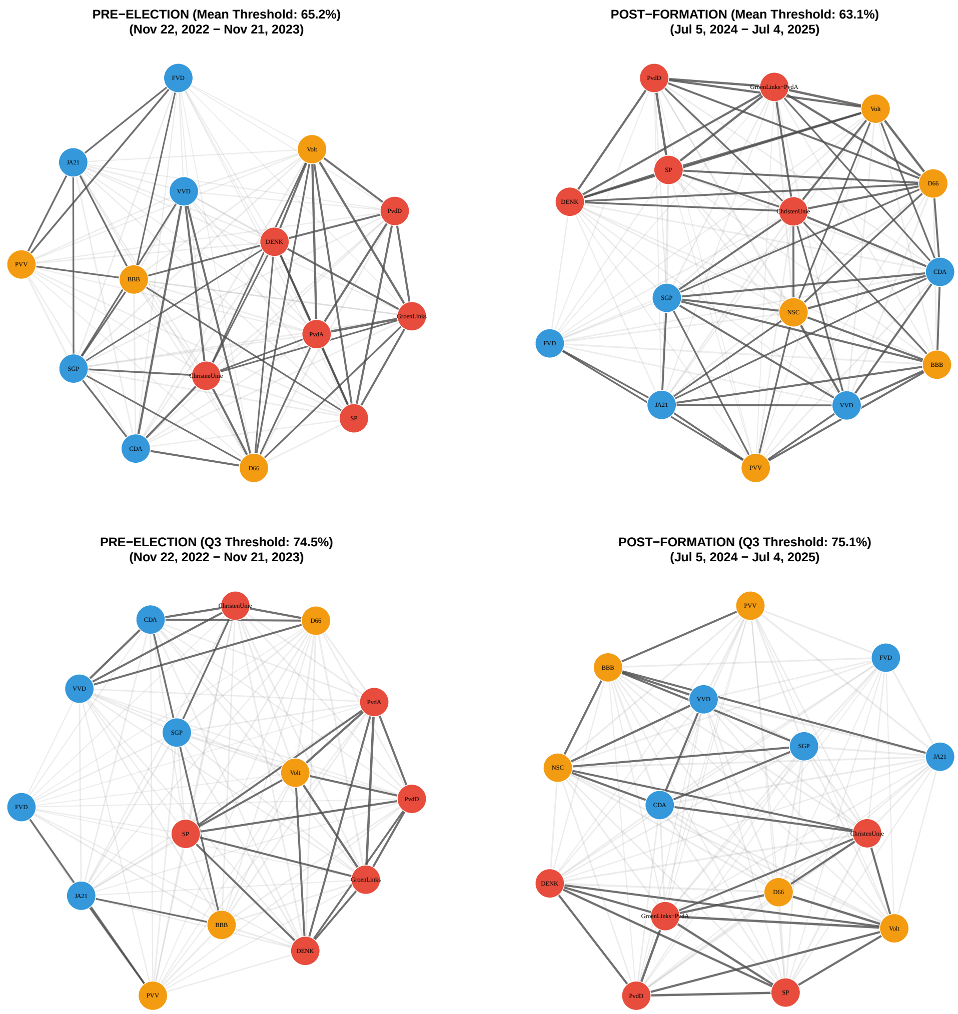


Table 3: Study 2 Network Structure by Threshold (Binarized)

Metric	Pre (Mean 63.9%)	Pre (Q3 74.5%)	Post (Mean 61.3%)	Post (Q3 74.9%)
Nodes (parties)	15	15	15	15
Edges	48	27	57	27
Density	0.46	0.26	0.54	0.26
Transitivity	0.68	0.89	0.74	0.61
Mean Degree	6.4	3.6	7.6	3.6
Isolates	0	0	0	1

Figure 2: Party Voting Networks by Period and Threshold. Darker edges indicate agreements above the threshold. Blue nodes represent right-wing parties, orange nodes represent centrist parties, and red nodes represent left-wing parties.



2.1.2 Supplementary Variables for Study 2

Supplementary data include:

1. Ideological positions from Kieskompas 2023 (ProDemos and Kieskompas, 2023), extracted from visualizations and mapped to left-right scales (-1 to +1). More details about the data extraction methodology can be found in the Appendix (Section 5.1).
2. Co-sponsorship relationships scraped from the same API we used to scrape voting records.
3. Coalition experience manually collected from parlement.com (*Kabinetsformaties sinds 1945 | Parlement.com*, n.d.), recording historical coalition frequencies between parties

A notable example from the co-sponsorship data is GroenLinks-PvdA, which had extensive co-sponsorship activity that ultimately led to their formal merger in 2023 (*GroenLinks-PvdA | Parlement.com*, n.d.). Table 4 provides summary statistics for both periods.

The coalition experience network contains 15 edges with mean 1.9 times (range 1-6), with CDA-VVD being the most frequent pair (6 times). The data extraction method for this data can also be found in the Appendix (Section 5.2). Both co-sponsorship and coalition experience are included as edge attributes in the voting networks, ideological positions are included as node attributes.

Table 4: Co-Sponsorship Network Statistics by Period

Metric	Pre_Election	Post_Formation
Total Edges	122	91
Mean Co-Sponsorship Count	31.4	52.1
Max Co-Sponsorship Count	359	385
Network Density	0.642	0.479

2.2 Data Usefulness and Potential Biases

These data are well-suited for studying electoral cycle dynamics because it enables temporal analysis through its use of timestamps, actual voting behavior provides objective preferences and combining voting data with ideology, coalition experience, and co-sponsorship allows testing multiple factors driving party cooperation.

A potential bias is the ideological measurement error from extracting Kieskompas coordinates (Bakker et al., 2015; Louwerse & Otjes, 2012), this however likely affects all parties equally and is mitigated by using ideology as a predictor rather than outcome. Temporal validity concerns (2023 ideology data vs. 2024 voting) are minimal as established party positions remain relatively stable (Gross & Debus, 2021).

3 Research Rationale

The first study investigates if there is a statistical difference in voting agreement in Dutch political parties before elections compared to after cabinet formation. This will be tested by creating two networks. The first network will be based on votes in the year preceding the 2023 elections, and the other based on votes in the year following cabinet formation. To test if there is statistical difference between these networks there are 3 options to test this: t-test, Quadratic Assignment Procedure (QAP), and Multiple Regression QAP (MRQAP). A t-test is not suitable for this type of data because voting relationships in a network are not independent of each other. Since if one party often agrees with another, it can influence how that party agrees with others as well. MRQAP focuses on explaining why certain edges exist by including predictor variables, which is not necessary for study 1.

QAP is the best option for this research, since QAP can directly compare two networks by calculating the correlation between the two networks and repeatedly permutes node labels to test if this difference is by chance or a statical significant difference.

The only assumption of QAP is that the networks that are used need to have the exact same vertices, which is not the case, because not all election parties join the cabinet. These small parties will be added with very low edge values so that both networks share identical node sets.

The second study examines why these differences in voting agreements in the networks are happening or not. This will be done with a Generalized Exponential Random Graph Model (GERGM). The difference between a GERGM and a traditional ERGM is that it allows weighted edges.This method is suitable for the data because it can work with weighted connections, which means it can use the exact level of voting agreement instead of reducing the data to simple yes/no ties. It is also possible to handle ties in a network that are not independent. The factors that will be added to the GERGM are the following terms:

The GERGM is suitable for the research question because it can test how ideological similarity, coalition position, and structural patterns in the network influence voting agreement between parties. This makes it possible to understand the mechanisms behind voting behaviour.

A bipartite ERGM was considered as an alternative, but this would model connections between parties and motions instead of direct cooperation between parties. It would also be much more complex without answering the research question as clearly. Traditional regression models were also not suitable because they assume independence between observations. So, the GERGM is the most appropriate method for study 2.

4 Appendix A: Network Threshold Selection Rationale

The thresholds were chosen with the aim to only include edges between parties that demonstrate a meaningful level, i.e. a sufficiently high ratio, of voting agreement. Firstly, a threshold at the mean was set to capture a broad set of relationships, creating edges between parties that agree more often than the mean agreement between parties. In contrast, the Q3 threshold keeps only the highest quartile of agreement values, therefore only forming edges between parties that show higher ratios of agreement. From a theoretical perspective, the Q3 threshold is more suitable to capture meaningful relationships, since only edges are formed between parties with a high level of agreement. Still, the mean threshold is used to evaluate whether the observed patterns persist under a broader and less restrictive definition of voting agreement, thereby providing a robustness check and supporting the generalizability of the results.

5 Appendix B: Supplementary Data Collection

5.1 Ideological Position Data Extraction

To capture the political positions of Dutch parties across the ideological spectrum, we relied on data from Kieskompas (ProDemos and Kieskompas, 2023), a research organization dedicated to analyzing political opinions and party positioning. During election cycles, Kieskompas condenses their findings into two-dimensional visualizations showing parties' positions on the left-right (economic) and progressive-conservative (cultural) axes.

Since Kieskompas does not publicly release the underlying coordinate data, we extracted numerical values from their published visualizations using plot digitization software. The primary data source was the 2023 election visualization (Figure 3). However, the 2023 data included GroenLinks-PvdA as a merged entity, while our pre-election analysis period (2022-2023) required separate coordinates for GroenLinks and PvdA. We therefore supplemented the 2023 data with coordinates for these two parties from previous Kieskompas election visualizations.

Coordinate extraction was performed using PlotDigitizer (plotdigitizer.com), a web-based tool for extracting numerical data from graph images. The digitization process involved:

1. Uploading the Kieskompas visualization image
2. Calibrating the x-axis (left-right dimension) and y-axis (progressive-conservative dimension) using known reference points
3. Manually selecting each party logo's center point to extract coordinates
4. Exporting the coordinate pairs to CSV format

Figure 4 shows the digitization interface with calibrated axes and extracted party positions. The final dataset contains coordinates for 21 parties on both ideological dimensions, which were then rescaled to the range [-1, +1] for use in our analysis.

Figure 3: Kieskompas 2023 Election Visualization (Source)

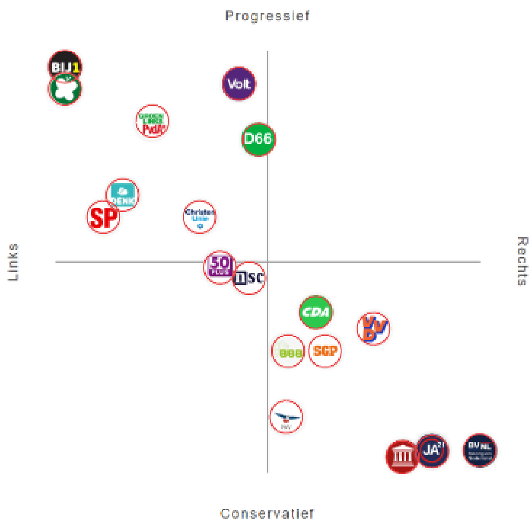
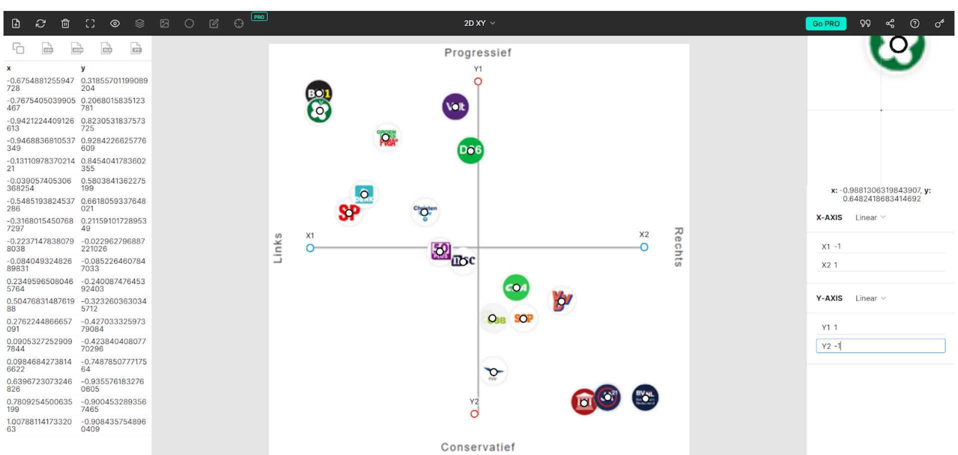


Figure 4: Plot Digitization Process using PlotDigitizer.com



5.2 Coalition Experience Data Collection

To capture historical coalition patterns between Dutch political parties, we collected data on cabinet formations from Parlement.com (*Kabinetsformaties sinds 1945 | Parlement.com*, n.d.), an authoritative source documenting all Dutch government formations since 1945. We focused on coalitions from the last 20 years (2003-2023) to ensure relevance to current party dynamics while capturing sufficient historical cooperation patterns.

The data collection process was entirely manual and involved:

1. Reviewing each cabinet formation listed on https://www.parlement.com/kabinetsformaties-sinds-1945
2. Identifying which parties participated in each coalition government within the 20-year window
3. Recording each unique party pair that served together in a cabinet
4. Counting the frequency of co-participation for each party pair across all coalitions

The resulting dataset contains 17 unique party pairs with co-coalition frequencies ranging from 1 to 6 times. For example, CDA and VVD served together in 6 different coalition governments, making them the most frequent coalition partners in our dataset. CDA also had 4 coalitions with ChristenUnie and 3 with D66. More recent coalition formations include BBB, NSC, and PVV each serving together once with VVD in the studied (2024) cabinet.

This dyadic coalition count data was structured as an undirected edge list (party A, party B, number of coalitions together) and stored in CSV format. In the ERGM analysis, this matrix serves as an edge covariate (`edgecov(coalition_matrix)`), testing whether historical coalition experience increases the likelihood of contemporary voting agreement between parties (H2.2).

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